



Description Logic

Summer Semester 2022

Exercise Sheet 5

25th May 2022

Prof. Dr.-Ing. Franz Baader, Dr. Oliver Fernández Gil

Exercise 5.1 Prove that the negation normal form (NNF) of an $\mathcal{ALC}$ -concept C can be computed in polynomial time and is equivalent to C .

Exercise 5.2 Execute the tableau algorithm $\text{consistent}(\mathcal{A})$ for the ABox

$$\mathcal{A} = \{(a, a):r, (a, b):r, (b, c):s, (c, a):s, a:\forall r.(A \sqcup B), b:\neg\exists s.(\forall r.\neg B \sqcup \exists s.B), c:\neg\exists s.\exists r.B\}.$$

If $\mathcal{A}$ is consistent, draw the model generated by the algorithm.

Exercise 5.3 We consider the concept constructor $\rightarrow$ (implication) with the following semantics:

$$(C \rightarrow D)^{\mathcal{I}} := \{x \in \Delta^{\mathcal{I}} \mid x \in C^{\mathcal{I}} \text{ implies } x \in D^{\mathcal{I}}\}.$$

To extend $\text{consistent}(\mathcal{A})$ to this constructor, we propose two alternative new expansion rules:

The deterministic $\rightarrow$ -rule

Condition: $\mathcal{A}$ contains $a:C \rightarrow D$ and $a:C$, but not $a:D$

Action: $\mathcal{A} \longrightarrow \mathcal{A} \cup \{a:D\}$

The nondeterministic $\rightarrow$ -rule

Condition: $\mathcal{A}$ contains $a:C \rightarrow D$, but neither $a:\neg C$ nor $a:D$

Action: $\mathcal{A} \longrightarrow \mathcal{A} \cup \{a:X\}$ for some $X \in \{\neg C, D\}$

For each rule, determine whether the resulting algorithm is still terminating, sound, and complete.